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Food profile and its effect on the occurrence of diabetes in patients living with HIV: A cross-sectional study at the Nylon district hospital, Cameroon

Blanche Cunégonde Omgba Etoundi *, **Lionel Fabrice Djomkam Youmsi**, **Danielle Émilie Mbock**, **Valère Cynthia Kayo Tayou**, **Martin Luther Koanga Mogtomo**

Department of Biochemistry, Faculty of Sciences, University of Douala, Cameroon

Abstract

Background: The increased nutritional needs associated with the initiation of antiretroviral therapy exposes HIV-positive patients to an uncontrolled diet. This places them at an increased risk for diabetes mellitus and highlights the role of nutritional habits in the development of diabetes mellitus amongst HIV patients. **Aim:** In this study, we sought to investigate the feeding habits and their effect on the occurrence of diabetes amongst HIV-positive patients at the Nylon District hospital. **Materials and Methods:** A hospital-based cross-sectional study was carried out over eight months. A total of 182 participants were randomly selected of which 134 were HIV-positive and 48 HIV-negative. Blood samples were collected after at least an eight-hour fast. **Results:** The prevalence of diabetes in the HIV-positive group was 19 % compared to 10 % in the HIV-negative group. The total cholesterol and triglyceride levels were higher in HIV-negative participants compared to HIV-positive participants. Consumption of dairy products more than once per day (OR= 0.71, 95 % CI: 0.27-1.89), vegetable consumption more than once per day (OR= 0.79, 95 % CI: 0.25-2.56), more than one meal per day (OR= 0.13 95% CI: 0.02-1.04), breakfast more than twice per week (OR= 0.91 95 % CI: 0.2-4.11), and practicing physical exercise (OR= 0.7 95 % CI: 0.28-1.78), reduced the odds of having diabetes in HIV positive participants. **Conclusion:** The HIV status has an impact on the occurrence of diabetes mellitus in these patients, and it is highly associated with the feeding habits and the lifestyle of these patients.

Keywords: HIV, diabetes mellitus, feeding habits, lifestyle, lipid profile.

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1 Introduction

Nutrition is the intake of food that is related to the body's dietary needs [1]. Good nutrition and an adequate, well-balanced diet combined with regular physical activity is the cornerstone of good health. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity [2]. Moreover, the nutritional requirements of patients with some chronic diseases, including those living with HIV, are particularly high due to the disease burden.

Energy requirements are likely to increase by 10 % to maintain body weight and physical activity in asymptomatic HIV-infected adults. During symptomatic HIV infection, and subsequently, during AIDS, energy requirements increase by approximately 20 % to 30 % to maintain adult body weight [3]. Upon an HIV infection, patients' food intake are ought to increase to meet the extra energy and nutrient needs. Such needs will increase even further as the HIV/AIDS symptoms develop [4]. The nutritional situation in these patients thereby makes the occurrence of diabetes and its management a challenge, due to their increased demands in caloric intake, the risk factor to the occurrence of diabetes is increased.

Recently compiled data show that approximately 150 million people have diabetes mellitus worldwide and that this number may well double by the year 2025 [5]. According to the national diabetes statistic report of 2017, in 2015 in the US, the prevalence of diabetes was 12.2 %, with 17.0 % in the age group 45 – 64 years [6]. Diabetes occurrence in HIV infected patients was always thought to be a result of antiretroviral therapy however, a study carried out in Cameroon by Grunfeld and Dankner in 2016 on HIV patients showed that these patients were more likely to have diabetes when not on antiretroviral therapy [7]. A study by Rhee and collaborators demonstrated that the prevalence of prediabetes and diabetes was higher in HIV patients with larger abdominal circumference (aOR = 1.07, 95% CI: 1.03 – 1.11) compared to patients on antiretroviral therapy (aOR = 0.46, 95% CI: 0.22 – 0.99) [8].

* **Corresponding author:** Etoundi Omgba Cunégonde Blanche, Department of Biochemistry. Faculty of Sciences, University of Douala. Cameroon. Tel: (+237) 695 41 89 79, E-mail: blancheetoundi@hotmail.fr

Therefore, the rationale of our study was to determine the factors other than the antiretroviral therapy, more specifically the impact of their nutritional habits on diabetes occurrence in HIV patients, and also to determine if the HIV infection in itself had a role to play in their nutritional habits. So, our study aimed at determining what are the feeding habits in HIV infected patients and how these feeding habits affect the occurrence of diabetes mellitus in people living with HIV who attended the Nylon district hospital in the town of Douala during the course of the study.

2 Material and Methods

2.1 Study setting

The study was carried out in the Nylon District Hospital, located in Douala in the quarter known as Dakar. It is located near the Douala International Airport and serves a great deal of the population of Douala especially the poor part of the town. It is the second larger treatment center for HIV patients after Laquintini Hospital in the Littoral region. The blood samples collected were analyzed in the Laboratory of the Nylon district hospital.

2.2 Participants

The study involved two groups of population: one group consisting of people living with HIV and another group with people not infected with HIV.

Equally among those living with HIV we distinguished those on highly active antiretroviral therapy (HAART) and those not on treatment. The study population included both males and females and it involved only adult patients. The participants were recruited within a period running from October to November 2017. Ethical approval for the study was obtained from the institutional ethical committee of research for human health of the University of Douala. Subjects were given full details of the study protocol. All of them gave written informed consent prior to participation in the study. The inclusion criteria were: HIV-positive and -negative patients followed up at the Nylon District Hospital, both male and female adult patients, both patients on antiretroviral therapy (ART) and also those not on ART, patients received at the outpatient department. The pediatric population, individuals who did not give their informed consent, and hospitalized patients were not included in the study.

2.3 Study design

In this cross-sectional study, all participants fasted during the last 08 hours prior to blood sample collection. The selection of participants was random as they came to the Laboratory of the hospital to carry out other Laboratory investigations, and it is after the selection that the participants were separated into two groups. Diet variety was assessed using a food frequency checklist and nutrient intake using 24-hours dietary recall [9]. We also recorded the amount of physical activity/week and this is because of the correlation between physical exercise and diabetes mellitus. According to Colberg *et al.*, multiple data showed that moderate exercise such as brisk walking reduces the risk of type 2 diabetes, and most studies support current recommendation of 2.5h/week of a moderate aerobic activity or typically 30 min/day for 5 days/week for prevention [10]. Anthropometric parameters (weight, height, body mass index, waist circumference, hip circumference) and body composition parameters (percentage fat, percentage water, percentage muscle) [11] were measured upon their arrival at the hospital, after which blood sample was then collected for Laboratory analysis. The weight was measured using a digital scale, the height using a stadiometer, the waist and hip circumference using a tape, and the body mass index was calculated using the weight and the height. The body composition parameters were measured using bioelectrical impedance analysis. Two readings of blood sugar levels were gotten in order to have a mean reading, and diabetes was diagnosed if a participant had a fasting blood sugar level equal or greater than 126mg/dl following an 8hr fast, with measurements done in the morning according to the American Diabetes Association [12]. Other parameters calculated were the patient's lipid profile, the C-reactive protein, glycated hemoglobin levels, and the serum creatinine levels, still from blood collected in the fasting state. The blood samples were collected with a 10 mL syringe into an EDTA tube and citrate tube. The participants were given some food after blood sample collection to amend their fasting state.

2.4 Statistical analysis

The data was entered into an Excel 2010 sheet (Microsoft Office, USA) and analyzed with EPI info version 7. Data were presented as percent and mean ± standard deviation (SD) for categorical and continuous variables, respectively. The one-way order of variance (ANOVA) was used to compare mean values between several groups ($n \geq 2$). Subsequently, Fisher's Pair Least Significant Difference (PLSD) test was used to compare two by two. Nonparametric Mann-Whitney and Kruskal-Wallis tests were used, respectively, to make comparisons between the averages of two groups and more than two groups. Multivariate analysis was done to assess the association of lifestyle and food habits with diabetes risk. The significance was set at a p-value <0.05.

3 Results

At the end of our study, 200 participants were selected but finally, 182 were enrolled in the study due to incomplete information in some of the questionnaires and for some inadequate blood samples for laboratory analysis. All the 182 participants retained were included in the data analysis. Of the 182 participants retained, 134 (73.63%) were HIV positive and 48 (26.37 %) were HIV-negative. The ages of the participants ranged from 15 to 71 years with the mean age being 44.70 ± 10.40 years. Most of the study participants were aged 45 – 49 years (21.43 %) and the majority of participants were females 132 (72.53 %).

Table 1: Frequency distribution of the nutritional habits of the participants between HIV positive and negative participants

Variables	Categories	Total (n =182)		HIV-positive (n =134)		HIV-negative (n =48)		p-value
		n	%	n	%	n	%	
Number of meals/day	1	6	3	5	4	1	2	0.5312
	2	66	36	46	34	20	42	
	3	100	55	74	55	26	54	
	4 or more	10	5	9	7	1	2	
Taking Breakfast	Yes	169	93	127	95	42	88	0.0543
	No	13	7	7	5	6	13	
Breakfast freq./week	1	11	6	9	7	2	4	0.1946
	2	14	8	8	6	6	13	
	3	21	12	19	14	2	4	
	4	18	10	11	8	7	15	
	5 or more	113	62	84	63	29	60	
	others	5	3	3	2	2	4	
Vegetable consumption/day	Once	67	37	48	36	19	40	0.0351
	2	24	13	18	13	6	13	
	3 or more	7	4	2	1	5	10	
	never	7	4	4	3	3	6	
	others	77	42	62	46	15	31	
Fruits consumption/day	1	87	48	62	46	25	52	0.6096
	2	24	13	16	12	8	17	
	3 or more	13	7	9	7	4	8	
	never	4	2	3	2	1	2	
	others	54	30	44	33	10	21	
Dairy-products consumption	1	82	45	58	43	24	50	0.4664
	2	10	5	6	4	4	8	
	3	5	3	4	3	1	2	
	4	34	19	24	18	10	21	
	5	51	28	42	31	9	19	

Table 2: Prevalence of diabetes mellitus in HIV positive and negative participants

Fasting blood glucose	Total		HIV-positive		HIV-negative		p-value
	N	%	n	%	n	%	
Low (< 0.6 g/dL)	1	1	1	1	0	0	0.2952
Normal (0.6 - 1.1 g/dL)	150	82	107	80	43	90	
High (> 1.1 g/dL)	31	17	26	19	5	10	
Total	182	100	134	100	48	100	

3.1 Anthropometric parameters

Figure 1 presents the mean of anthropometric and body composition parameters for both HIV-positive and HIV-negative participants. The mean weight was high in HIV-positive participants (76.8 ± 15.7 kg) as compared to HIV-negative participants (73.8 ± 17.3 kg). Of statistical significance was the body water of the participants (this sentence needs to be revised), which was averagely higher in HIV-positive participants (47.7 ± 8.4 %) as compared to HIV-negative participants (43.2 ± 7.8 %).

3.2 Nutritional habits of the participants

The proportion of our participants who consumed 4 or more meals per day was higher amongst the HIV-positive population (7 %) compared to the HIV-negative population (2 %). The proportion of the participants who took breakfast was higher in the HIV-positive population (95 %) compared to the HIV-negative population (88%). More than-51% of the HIV-negative participants ate vegetables more frequently per day with the highest frequency being 3 and more times per day (10 %) as compared to HIV-positive participants (1%). This is in concordance with the proportion that never consumes vegetables which was more in HIV-positive participants (46 %) as compared to HIV-negative participants (31 %). Fruit consumption frequency was almost similar in the two groups of participants even though slightly higher in HIV-negative participants, with 8 % consuming fruits 3 times or more compared to 7 % in HIV-positive participants (Table 1).

3.3 Prevalence of diabetes

Most of the study participants (82%) had a normal blood sugar level. High blood sugar levels were seen in 17 % and low blood sugar in 1% of our study population. Amongst the participants with high blood sugar levels, 19 % were HIV-positive and 10 % were HIV-negative (Table 2).

3.4 Diabetes complications

The diabetes risk factors were calculated as means and comparisons were made between HIV-positive and HIV-negative participants, which was then represented on the bar chart as shown in Figure 2. The total cholesterol levels were higher in HIV-negative participants as compared to HIV-positive participants (191.4 ± 54.6 vs. 168.6 ± 45.8). The same trend was observed with LDL cholesterol and HDL cholesterol. Also, the average triglyceride levels in HIV-negative patients were higher 120.0 ± 54.3 as compared to 97.8 ± 54.9 in HIV-positive participants. The glycated hemoglobin levels were almost similar in the two groups (5.82 ± 1.20 vs 5.60 ± 0.62 %) in HIV-positive vs HIV-negative participants respectively as well as the serum creatinine levels (0.88 ± 0.32 vs 0.83 ± 0.02 %) in HIV-positive and HIV-negative participants respectively.

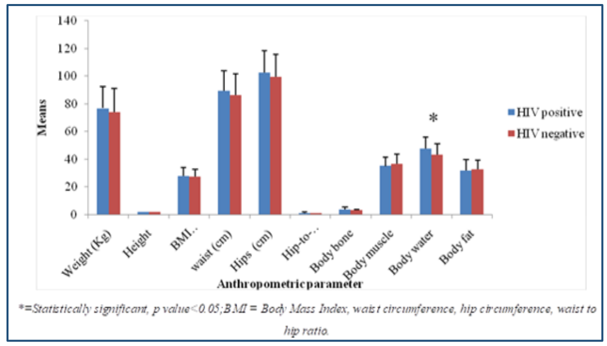

Figure 1: Mean distribution of the anthropometric parameters of study participants

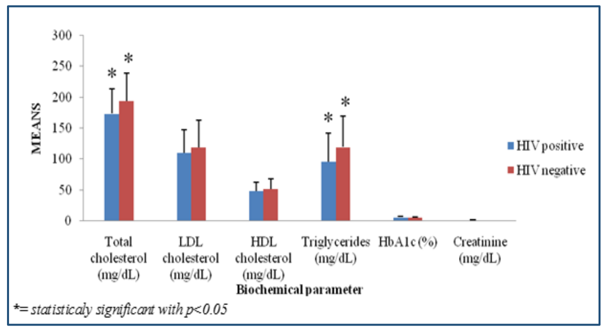

Figure 2: Mean distribution of diabetes complications between HIV-positive and negative

3.5 Association of feeding and lifestyle habits with the occurrence of diabetes mellitus

The feeding and lifestyle habits of our participants were not significantly associated with the occurrence of diabetes, however, there were some associations. The lack of significance will be further discussed in the discussion section. The HIV-positive participants who did not take breakfast were more likely to have diabetes (OR= 1.09, 95 % CI: 0.15 – 7.78). However, the association was higher in HIV-negative participants (OR= 7.96, 95% CI: 0.29 – 218.36). Consumption of dairy products 1 – 3 times per day had a negative association with the occurrence of diabetes in the sense that it reduced the odds of having diabetes amongst the HIV-positive participants (OR= 0.71, 95 % CI: 0.27 – 1.89). However, in HIV-positive participants, there was a positive association (OR= 11.82, 95% CI: 0.49 – 285.04). Vegetable consumption more than once per day reduced the risk of having diabetes in HIV-positive participants as well as in HIV-negative participants, but the odds were higher in HIV-positive participants (OR= 0.71, 95% CI: 0.27 – 1.89) compared to HIV-negative participants (OR= 0.06, 95 % CI: 0.003 – 1.22), with a borderline statistical significance (p=0.067).

Table 3: Multivariate analysis of lifestyle- and food habits-related factors associated with diabetes risk

Factors	Categories	HIV-positive aOR (95%CI)	p-value	HIV-negative aOR (95%CI)	p-value
Breakfast?	Yes	1		1	
	No	1.09(0.15-7.78)	0.9329	7.96 (0.29-218.36)	0.2194
Dairy product /day	Never	1		1	
	1-3	0.71(0.27-1.89)	0.4945	11.82 (0.49-285.04)	0.1283
Vegetable consumption/day	Never	1		1	
	1-3	0.79(0.25-2.56)	0.6973	0.06 (0.003-1.22)	0.0671
Fruit consumption/day	Never	1		1	
	1-3	1.33(0.43-4.13)	0.6196	0.7 (0.05-8.99)	0.7849
Number of meals/day	once	1		1	
	More than once	0.13 (0.02-1.04)	0.0548	4717 (0-1×10E12)	0.9766
frequency of breakfast/week	≤ 2	1		1	
	> 2	0.91 (0.21-4.11)	0.9064	2.10 (0.13-33.85)	0.6021
Physical exercise/week	Never	1		1	
	1-5	0.7 (0.28-1.78)	0.4571	0.26 (0.03-2.46)	0.2384
Alcohol consumption	Never	1		1	
	Moderate-elevated	1.08 (0.37-3.15)	0.8797	2.78 (0.14-52.84)	0.2194
Smoking	No	1		1	
	Yes	2.02 (0.54-7.54)	0.2938	4.75×10^{-6} (0.0 -)	0.9812

aOR = adjusted odds ratio, HIV = Human immunodeficiency virus, 95%CI = confidence interval at 95%; Multivariate logistic regression analysis was used to identify factors associated with diabetes incidence with regard to HIV status, Significance was set at p-value less than 0.05.

Fruit consumption more than once per day had a positive association with the occurrence of diabetes in HIV-positive participants (OR= 1.33. 95% CI: 0.43 – 4.13), however in HIV-negative participants there was rather a negative association (OR= 0.71, 95 % CI: 0.05 – 8.99). More than one meal per day had a negative association with the occurrence of diabetes in HIV-positive participants (OR= 0.13, 95% CI: 0.02 – 1.04). However, the association was extremely high in HIV-negative participants (OR= 4717, 95% CI: 0 – 1 × 10E12). Amongst the participants, those who took breakfast more than 2 times per week had lesser chances of having diabetes in HIV-positive participants (OR= 0.91, 95% CI: 0.21 – 4.11), whereas the association was positive in HIV-negative participants (OR= 2.10, 95% CI: 0.13 – 33.85). Physical exercise had a negative association with the occurrence of diabetes in both groups of participants, however, HIV-positive participants had an increased likelihood of having diabetes compared to HIV-negative participants (OR= 0.7, 95% CI: 0.28 – 1.78 vs OR= 0.26, 95% CI: 0.03 – 2.46). Alcohol consumption had a positive association with the occurrence of diabetes in both HIV-positive and HIV-negative participants. However, HIV-positive participants had less likelihood of developing diabetes compared to HIV-negative participants (OR= 1.08, 95% CI: 0.37 – 3.15 vs OR= 2.78, 95% CI: 0.14 – 52.84). Smoking had a positive association with the occurrence of diabetes, with HIV-positive participants more likely to have diabetes compared to HIV-negative participants (OR= 4.75 × 10E6 vs OR= 2.02, 95% CI: 0.54 – 7.54) (Table 3).

4 Discussion

The prevalence of diabetes among our study participants is 17.03 %, which is higher than the global prevalence of diabetes which is at 8.8 % as of 2015 according to the IDF (international diabetes federation) [13]. Our higher value could be explained in the view of the nutritional habits of the underdeveloped areas are becoming more and more westernized. The prevalence of diabetes is 5.7 % in urban Cameroon [14], this value is much lower compared to our result and this can be explained by the fact that the study was carried out 10 years ago and over time the exposure to risk factors have been increasing in our environment coupled with the increase in diagnosis rates. The prevalence of diabetes in HIV-positive participants (19 %) was higher than that in HIV-negative participants (10 %). Hernandez and collaborators found in a previous study that diabetes mellitus (DM) prevalence among HIV-infected adults was 10.3 % (95 % CI 9.2 % to 11.5 %) [15]. Our result was higher, and this could be explained by the switch from a developed to an underdeveloped setting. However, our result was similar to that of Kalra and collaborators in a study carried out in India which showed a prevalence of 18 % by IDF criteria [16].

Consumption of vegetables amongst the study participants was associated with the HIV status (p = 0.0351) in that HIV-positive participants consumed vegetables generally more often than HIV-negative participants, with 5 times weekly being the greatest consumption rate among HIV-positive participants. Wrottesley and collaborators in South Africa in a study carried out amongst HIV-positive women concluded that most of them were on vegetable consumption and these had a positive effect on the immunocompetence of these patients [17]. Intake of fruits (p= 0.6096), dairy products (p= 0.4664), breakfast (p= 0.1946) and the number of meals per day (p= 0.9325) were not associated with the HIV status of the participants. In our study the relationship between BMI and diabetes risk was not statistically significant, this can be explained by the fact that with the HIV co-infection in some of our study participants, the weight loss was multifactorial.

The total cholesterol levels were higher in HIV-negative participants as compared to HIV-positive participants (p= 0.0042). Also, the average triglyceride levels in HIV-negative patients were higher compared to HIV-positive participants (p= 0.0037). Our findings were similar to those of Baza and collaborators who reported lower total cholesterol and triglyceride levels amongst HIV-positive homosexual males as compared to HIV-negative participants [18]. Differences regarding other lipid profile components were not statistically significant.

In our study, HIV-positive participants who did not take breakfast were more likely to have diabetes (OR= 1.09, 95% CI: 0.15 – 7.78) however the association was not statistically significant (p = 0.2194) The association was higher in HIV-negative participants (OR= 7.96, 95% CI: 0.29 – 218.36). Amongst the participants, those who took breakfast more than 2 times per week decreased risk of having diabetes in HIV-positive participants (OR= 0.91, 95% CI: 0.21 – 4.11), whereas the association was positive in HIV-negative participants (OR= 2.10, 95% CI: 0.13 – 33.85). Our findings were however not statistically significant. Our findings corroborate those obtained by Goon and collaborators in 2014, who found out that skipping breakfast was associated with an increased risk of diabetes (OR= 1.256, 95% CI: 1.043 - 1.511)[19] as seen in the HIV-negative participants. This could be explained by the fact that skipping breakfast may lead to an increase in appetite leading to obesity and eventually diabetes. However, the negative association in HIV-positive participants could be attributed to their HIV status where there is already a deficiency in nutrients requirement; hence, the increase in appetite may even be advantageous for them instead. Consumption of dairy products 1 – 3 times per day had a negative association with the occurrence of diabetes in the sense that it reduced the odds of having diabetes amongst the HIV-positive participants (OR= 0.71, 95% CI: 0.27 – 1.89). However, in HIV-negative participants, there was a positive association (OR= 11.82, 95% CI: 0.49 – 285.04). Our findings were however not statistically significant (p>0.05) which may be explained by our smaller sample size. Our findings amongst HIV-positive participants differed from those of Elwood and collaborators in terms of sample size used but the outcome was similar as in their study they described a negative association between dairy product consumption and development of metabolic syndrome and eventually diabetes [20]. However, the association was positive in HIV-negative participants, probably due to the reduced need compared to the HIV-positive participants. There was no difference in the chance of having diabetes after Vegetable consumption more than once per day in HIV-positive participants as well as in HIV-negative participants (OR= 0.71, 95% CI: 0.27 – 1.89 vs OR= 0.06, 95% CI: 0.003 – 1.22). Liang and collaborators in 2017, in a study in China also had a negative association between vegetable consumption and diabetes (OR= 0.68 95% CI: 0.46-0.98) [21].

There was no difference in the association of fruit consumption more than once per day with diabetes occurrence in HIV-positive participants (OR= 1.33. 95% CI: 0.43 – 4.13) and in HIV-negative participants (OR= 0.71, 95% CI: 0.05 – 8.99). Cooper and collaborators in a meta-analysis in Europe also found a negative association between fruit consumption and diabetes (OR= 0.70, 95% CI: 0.53–0.91) [22] as was the case with the HIV-negative participants in our study. However, there was a positive association between fruit consumption and diabetes in HIV-positive participants. This could be explained by the fact that in HIV-positive participants there is a nutrient absorption deficit and therefore greater quantities will have to be taken to get the same effects.

There was no difference in the association of having more than one meal per day in HIV-positive participants (OR= 0.13, 95% CI: 0.02 – 1.04) and HIV-negative participants (OR= 4717, 95% CI: 0 – 1 × 10E12). Also, there was no difference in the association of diabetes and physical exercise in HIV-positive participants (OR= 0.7, 95% CI: 0.28 – 1.78) and HIV-negative participants (OR= 0.26, 95% CI: 0.03 – 2.46). However, we noted a negative association between physical exercise and diabetes in both HIV-positive and negative patients which is similar to the findings by Ghaderpanahi and collaborators in Iran, who equally described a negative association between physical exercise and diabetes (OR= 0.56; 95%CI: 0.35–0.91) [23].

Alcohol consumption had a positive association with the occurrence of diabetes, however, there was no difference in HIV-negative participants (OR= 2.78, 95% CI: 0.14 – 52.84), compared to HIV-positive participants (OR= 1.08, 95% CI: 0.37 – 3.15). Our findings corroborate those of Lee and collaborators who found out that heavy drinking increased the risk of the incidence of diabetes mellitus [24], even though our result was not statistically significant which may be explained by a larger sample size in the study Lee and collaborators.

Smoking had a positive association with the occurrence of diabetes, which was more in HIV-negative participants (OR= 4.75×10^6) compared to HIV-positive participants (OR= 2.02, 95% CI: 0.54 – 7.54). Foy and collaborators had similar results in the US, where they showed a robust association between smoking and the incidence of diabetes (OR= 2.66) [25]. However, our finding was not statistically significant compared to the study by Foy and collaborators, which may be explained by a larger sample size in the study by Foy and collaborators. This

could be explained by the fact that smoking affects the insulin sensitivity of the cells hence increasing insulin resistance leading therefore to diabetes mellitus.

Study limitations

The study limitations in our study were as follows:

- The participants were not hospitalized patients but Outpatient so their dietary habits were obtained from verbal reports of the patients and were not controlled by the study contributors.
- The 8hr fasting period before fasting blood sugar measurement were not controlled by us acquired from participants' reports.
- Also, our sample size was relatively smaller thereby making some of our results not statistically significant.

5 Conclusions

The Food profile that was related to the HIV status of the participants with statistical significance was vegetable consumption which was higher in HIV-positive participants as opposed to the HIV-negative participants. The prevalence of diabetes in our population was 17.03 %, with the prevalence being higher amongst HIV-positive participants (19 %) as compared to HIV-negative participants (10 %). Total cholesterol levels and triglyceride levels were higher in HIV-negative participants as opposed to HIV-positive participants. Consumption of dairy products more than once per day, vegetable consumption, more than one meal per day, breakfast more than 2 times per week, and physical exercise reduced the likelihood of developing diabetes however there was no statistically significant difference between HIV-positive and negative patients, whereas fruit consumption more than once per day, not taking breakfast at all, smoking, alcohol consumption increased the likelihood of developing diabetes in people living with HIV at the Nylon District Hospital, however, there was no statistically significant difference between HIV-positive and negative patients.

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